Small scale assessment of anthropometric parameters and cardiorespiratory fitness in female bakery workers of Palpa, Nepal

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Abstract

Background: In recent years bakery industries are one of the fastest growing small agro industries creating impact of daily life of Palpa district. Female bakery workers of Palpa district, face some extreme condition like working on hot environment creating by furnace, inhalation of flour dust etc that leads to make them challenging, which prompted us to assess occupational cardio respiratory health status of these bakery workers.

Materials and Methods: This study was conducted in Palpa district of Nepal. 24 female bakery workers Age: 25 –35 years were chosen and they involved in this occupation since more than one year. 18 healthy female subjects of same age group, mostly working as house wife were chosen as control subjects were recruited for the study from the same locality. Different physical, anthropometric and physiological parameters were studied according to standard procedure. Students “t” test was performed to find out the significant difference (P<0.05), if any, between the selected variables.

Results: Results of this study on female bakery workers suggest that they are physically healthy but having poor cardio respiratory fitness.

Conclusion: In this small scale study, the female bakery workers of Palpa district suffering from heat stress and chronic pulmonary obstructions. To develop an effective intervention strategy, the treatment seeking behavior of individuals would also need to be improved through awareness program.

Keywords: Female bakery workers, heat stress, flour dust, respiratory rate, peak expiratory flow rate, physical fitness index.

1. Introduction

The Kingdom of Nepal, a landlocked country is situated in South Asia between India and China. Geographically, it is located between latitudes 26°22′N and 30°27′N and longitudes 80°4′E and 88°12′E. Its altitude varies from 80 meters above from mean sea level in the southern Terai to 8,848 meters (the Mount Everest) is the northern Himalaya.3 The present study was conducted in Palpa district, which is a part of Lumbini zone, with a total area of 1,373 km². The total population of the district is 268,558 according to 2001 census. Currently the overall literacy rate (for population aged 5 years and above) has increased from 54.1% in 2001 to 65.9% in 2011. The male literacy rate being 75.1% and it is higher than female literacy rate which is only 57.4% in Palpa district4.

The local economy of Palpa district depends mainly on agriculture, animal husbandry, small industries, tourism and remittance. In recent years bakery industries are one of the fastest growing small agro industries creating impact of daily life of Palpa district. Bakery products are being used on large scale as daily food item in developing countries like Nepal.

Different research work has been conducted to establish the patho-physiological status of bakery workers like allergic condition, respiratory problems, sensitization etc. due to daily exposure of flour dust5,6. Bakery industries in Palpa district employ both males and females of different age groups. They are always being exposed to the hot environment of blast farness as well as flour dust and in the micro environment of leaving agents of baking. Reliable and true informations of health problems of a population is one of the most essential pre requisites for formulating health care system to address health needs effectively7. Palpa district is experiencing a health transition which posing a great challenge to its health system due to the changes in health needs of the population. There may be some occupation induced health problems like obesity, hypertension, chronic pulmonary dysfunctions etc. in the employees. The previously reported information regarding health problems and nutritional status among bakery workers is not adequate for proper public health planning for the bakery workers. In fact, there is no such data available about physical and physiological status of bakery workers.

Hence we conducted a study with an objective to identify the physical, physiological and nutritional status of female bakery workers of Palpa district in Nepal. The findings may allow us to discuss about the health scenario of female bakery workers and their challenging life-styles which will be important public health concern.

2. Methods and Materials

2.1 Participants

This study was conducted in Palpa district of Nepal. 24 female bakery workers Age: 25 –35 years were chosen and they involved in this occupation since more than one year. 18 healthy female subjects of same age group, mostly working as house wife were chosen as control subjects were recruited for the study from the same locality. Both the individuals (worker and control), had no earlier report of systemic diseases.

2.2 Measurement of height

The height (cm) of each subject was measured by an anthropometric rod by allowing the subject to stand straight on a plane surface. They were instructed to look forward during the measurement.

2.3 Measurement of weight

The weight (kg) of each subject was measured by conventional weighing pan. They were instructed to stand upon it and to look forward. Weighing pan was reset to zero before each measurement.
2.4 Calculation of Body Surface Area (B.S.A.) and Body Mass Index (B.M.I.)

Calculation of body surface area of each individual was measured by height-weight nomogram. The body mass index (or Quetelet Index) is the statistical measure which compares a person’s weight and height by the following formula: \( BMI = \frac{mass}{(Height \text{ in } m)^2} \). The WHO regard a BMI of less than 18.5 as underweight and may indicate malnutrition, an eating disorder, or other health problems, while a BMI greater than 25 is considered overweight and above 30 is considered obese.

2.5 Measurement of heart rate

The heart rate (beats/min) of each subject was measured in seating condition after 15 mins of rest by a stop watch from the radial artery.

2.6 Measurement of systolic and diastolic blood pressure

Systolic and diastolic blood pressures (mmHg) of the subjects were measured with the help of sphygmomanometer. Both the pressures were measured by allowing the subject in seating position after 15 mins of rest.

2.7 Physical fitness index (PFI)

PFI was calculated by measuring HR after performing Harvard’s step test (HST) developed by Brouha et al. in the Harvard Fatigue Laboratories using long form PFI equation. However, following modified HST under Indian condition, a stool of 51 cm high stepping up and down, with a rate of 30 cycles/min, for 3 min or up to exhaustion. Exhaustion is defined as when the subject cannot maintain the stepping rate for 15 sec. The recovery pulse was counted at 1-1.5, 2-2.5 and 3-3.5 min of recovery. Long Form Equation: Fitness index = \[ \left( \frac{100 \times \text{test duration in seconds}}{2 \times \text{recovery HRs (1-1.5 min + 2-2.5 min + 3-3.5 min)}} \right) \]. The cut-off values of PFI are: Very poor (<50), poor (50-60), fair (60-70), and good (70-80) and excellent (>80).

2.8 Measurement of Peak Expiratory Flow Rate (PEFR)

Peak expiratory flow rate was examined with an Airmed peak flow meter. The test was performed in standing position holding the peak flow meter horizontally. A tight fitting disposable cardboard mouthpiece was inserted in the inlet nozzle. After proper rest, subject was requested to take a deep breath and exhale as forcefully as possible in one single blow into the instrument. The procedure was repeated three times and best of the three was recorded.

2.9 Statistics

All the represented data were analyzed statistically by using SPSS v.15.0 and MS-Excel v.2013. If differences between the groups were established, the values of the treated groups were compared with those of the control group by a modified t-test. A value of P < 0.05 was interpreted as statistically significant.

### 3. Result

Both height and body weight were higher in female bakery workers as compared to control subjects and they were statistically insignificant. The similar pattern of result was also observed in BSA and BMI. Data of Height (cm), weight (kg), BMI (kg/m²), BSA (m²) and respiratory rate (breaths/min) of female bakery workers and their control counterparts were presented in Table 1. Normal respiratory rate is significantly higher in female bakery workers. In our present study, peak expiratory flow rate and PFI these two groups were presented in Fig 1. Peak expiratory flow rate (l/min) was presented in Fig 2. Systolic blood pressure and Resting heart rate were found to significantly higher in female bakery workers as compared to control subjects (Fig 1). In our present study, peak expiratory flow rate and PFI these two parameters are significantly lower in female bakery workers.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control Subjects (n=18)</th>
<th>Female Bakery Workers (n=24)</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>148.43</td>
<td>3.41</td>
<td>149.80</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>59.03</td>
<td>6.42</td>
<td>62.50</td>
</tr>
<tr>
<td>BSA (m²)</td>
<td>1.52</td>
<td>0.07</td>
<td>1.57</td>
</tr>
<tr>
<td>BMI (Kg/m²)</td>
<td>26.85</td>
<td>3.30</td>
<td>27.87</td>
</tr>
<tr>
<td>Respiratory Rate (breaths/min)</td>
<td>16.00</td>
<td>1.28</td>
<td>16.92</td>
</tr>
</tbody>
</table>

NS: Not significant.

Figure 1: Systolic and diastolic BP (mmHg), PFI, Resting heart rate (beats/min) of control (n=18) and female bakery workers (n=24)
In this study it is evident that bakery workers and control group of subjects had no significant association in terms of weight, height, BSA and BMI. So, in this study both groups of subject viz. control and female bakery workers were standardized in terms of weight, height, BSA and BMI. BMI is considered as a better index for assessing obesity, because it does away with the need of height-weight tables and is independent of type of obesity frame and can be used to estimate the prevalence of obesity within a population \cite{11,12}. Therefore, in the present study, the body composition of female bakery workers was calculated according to critical limits of BMI as recommended by WHO. Further on analyzing the physical characteristics of the subjects, it was observed that the mean BMI value of the female bakery workers were within the normal range (Normal BMI: 18-25 kg/m2), as per classification by WHO.

Though the blast farness is the only tool for bakery industries, thus it has an impact of generation of hot environment inside the industrial place. The bakery workers are working inside the industry, thus they might be suffering from heat stress. The temperature has a great impact on heart rate; it is also well known that heat stress may represent an additional load on the cardiovascular system. This is evidenced by an elevated heart rate at the same work load in a hot environment versus a room temperature environment \cite{16}. May be due to this reason, the bakery workers has a significantly higher resting heart rate. In addition to transport of oxygen by circulating blood volume, also helps to serve as a cooling fluid. It, therefore, transports heat from the interior of the body to the skin where it is dissipated to the surrounding environment by conduction, convection, radiation and sweat evaporation. This requires an increase in speed of the blood circulation, i.e. the cardiac output has to be elevated. This can only be done by increasing the stroke volume of the heart and/or increasing the heart rate. Since the possibility of increasing the stroke volume of the heart is limited, a major increase in the minute volume can only be achieved by an increase in the heart rate \cite{16}.

Flour dust is a heterogeneous substance with respiratory sensitizing and irritating properties, its exposure during mixing and baking processes may induce acute or chronic respiratory ailments \cite{17}. Normally due to flour dust inhalation, the sensory receptors present on respiratory mucosa get stimulated, which initiate sneezing reflex to dislodge the inhaled flour dust from the respiratory passage. But on long term exposure to flour dust for several months or years as seen in bakery workers the flour dust which get lodged into the respiratory passage may cause the airway obstruction (airway hyper-responsiveness) leading to less supply of air (O2) into lungs alveoli. This may lead to increase in rate (tachypanea) and depth of the respiration to meet more O2 demand.

PFI scores are useful measures of fitness for strenuous exercises. Physical fitness has three main aspects: Static fitness (absence of disease), dynamic fitness (ability to perform strenuous work) and motor skills fitness. Of this three, dynamic fitness is very important and can be measured by HST \cite{11,12}. While measuring physical fitness, their pulse rate recovered quite slowly; this is an indicator of poor fitness of the female bakery workers, and thus, reflected in PFI.

The blood pressure is a great impact parameter for People’s occupation as well as well known marker of hypertension (Hypertension was defined as systolic blood pressure more than 140 mmHg and/or diastolic blood pressure 90 mmHg or above) \cite{18}. Both systolic and diastolic blood pressure was significantly higher in female bakery workers and thus has got the above criteria for hypertension. So the results of blood pressure in this study suggested the prevalence of hypertension in female bakery workers.

PEFR can be expressed as person's maximum speed of expiration. Our study showed decrease in PEFR in bakery workers as compare to the control group. The underlying mechanism of air way obstruction may be due to association with flour dust and may be due to the formation of specific IgE leading to immunological reactions which can be immediate, late or dual or materials being employed cause a direct liberation of broncho constrictor substances \cite{19}.

5. Conclusion

In Palpa (Nepal), the female bakery workers spend their life with a challenge. This study supports a hypothesis that the female bakery workers are suffering from heat stress and chronic pulmonary obstructions as well as a tendency of hypertension. It also may suggest that the cardio respiratory fitness is decreasing gradually after a long time engagement as a bakery worker. We suppose that we need to assess more physical and physiological parameters according with the male and female both sex variations. Effective intervention needs to be formulated for this population through some awareness program.

Acknowledgement

We want to convey our vote of thanks to all active participants for their co-operation.

References

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